PATENT ABSTRACTS OF JAPAN

(11)Publication number : **09-318362**
(43)Date of publication of application : **12.12.1997**

(51)Int.Cl. **G01C 19/56**
G01P 9/04

(21)Application number : **08-137023**
(22)Date of filing : **30.05.1996**

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(54) **ELASTIC SURFACE WAVE GYROSCOPE**

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce position accuracy of an IDT(interdigital transducer) or the like without lowering the detection accuracy.
SOLUTION: An IDT 101 for detecting a Coriolis force is arranged at the center of the surface of a piezo-electric substrateIDTs 102 and 103 for generating elastic surface waves on both sides thereof and moreoverreflector pairs 104 and 105 on both sides thereof... all in one row. A detection signal of the IDT 101 is inputted into a positive terminal of a differential amplifier 34 of a detection circuit 31. A high frequency oscillator 32 using an elastic surface wave resonator is built on the piezo-electric substrate and an output thereof is inputted into the IDTs 102 and 103 and a phase shifter 33 of the detection circuit 31. The phase shifter 33 corrects a phase based on distances between the IDT 101 and the IDTs 102 and 103 to generate a signal corresponding to a detection signal component attributed to the elastic surface wave as vibration source. A signal component attributed to the elastic surface wave is removed by the differential amplifier 34 from the detection signal of the IDT 101 and the detection signal component alone attributed to the Coriolis force is detected.

CLAIMS

[Claim(s)]
[Claim 1]A surface acoustic wave gyroscope comprising:
A piezoelectric board.
An electrode for detection which detects Coriolis force which was formed in the surface of the above-mentioned piezoelectric boardand in which voltage conversion was carried out by the piezo-electric effect.

An electrode for a drive of a couple which is formed in both outsides of the above-mentioned electrode for detectionand generates a surface acoustic wave.
An electrode for antenna reflectors of a couple which is formed in both outsides of an electrode for a drive of the above-mentioned coupleand reflects the above-mentioned surface acoustic wave in the above-mentioned electrode side for detectionA high frequency creating means which generates high frequency impressed to the above-mentioned electrode for a drivea signal generating means which generates a signal equivalent to vibration based on the above-mentioned surface acoustic wave in which voltage conversion was carried out by the piezo-electric effectand a signal output means which outputs a difference signal of a detecting signal from the above-mentioned electrode for detectionand an output signal from the above-mentioned signal generating means.

[Claim 2]A surface acoustic wave gyroscope comprising:
A piezoelectric board.
The 1st electrode for a drive to which the 1st high frequency is impressed in order to be formed in the above-mentioned piezoelectric board surface and to generate the 1st surface acoustic wave.
The 2nd electrode for a drive to which the 2nd high frequency is impressed in order to generate the 2nd surface acoustic wave that has frequency which is formed in the above-mentioned piezoelectric board surfaceand is different from the 1st surface acoustic wave of the above.
The 1st high frequency creating means that generates the 1st high frequency of the aboveand the 2nd high frequency creating means that generates the 2nd high frequency of the aboveThe 1st electrode for antenna reflectors of a couple that is formed in both outsides of the above 1st and the 2nd electrode for a drive in order to generate a standing wave of the 1st surface acoustic wave of the aboveand reflects the 1st surface acoustic wave of the above in the 1st electrode side for a driveThe 2nd electrode for antenna reflectors of a couple that is formed in both outsides of the above 1st and the 2nd electrode for a drive in order to generate a standing wave of the 2nd surface acoustic wave of the aboveand reflects the 2nd surface acoustic wave of the above in the 2nd electrode side for a driveIt is formed in both outsides of the above 1st and the 2nd electrode for a drive in order to make into a standing wave the 3rd surface acoustic wave based on Coriolis force generated by an interaction of an interference wave of the 1st surface acoustic wave and the 2nd surface acoustic waveand rotational movement of a piezoelectric boardThe 3rd electrode for antenna reflectors of a couple that reflects the 3rd surface acoustic wave of the above in the 1st and 2nd electrode side for a driveAn electrode for detection which responds distorted and detects an electrical signal which is formed in the above 1st and the 2nd inter-electrode one for a driveand originates in the above-mentioned Coriolis force according to the piezo-electric effectand to generateand a signal generating means which generates a signal equivalent to vibration based on the 3rd elastic surfaces of the above in which voltage conversion was carried out by the piezo-electric effectA signal output means which outputs a difference signal of a detecting signal from the above-mentioned electrode for detectionand an output signal from the above-mentioned signal generating means.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the surface acoustic wave gyroscope which changes into voltage the Coriolis force generated in a substrate face by the interaction of the surface vibration by the surface acoustic wave of a piezoelectric boardand rotational movement of a piezoelectric board according to the piezo-electric effectand detects it.
[0002]
[Description of the Prior Art]The gyroscope using a surface acoustic wave is proposed so that it may be shown in the formerfor exampleJP6-281465A.
[0003]In the above-mentioned gazetteone interdigital type transducer of a piezoelectric board which detects Coriolis force on the surface on the other hand. (it is hereafter called IDT for detection (Inter-Digital Transducer).) -- IDT of the couple which inserts and generates the surface acoustic wave of the same frequency. (it is hereafter called IDT for a drive.) -- the surface acoustic wave gyroscope which has the composition which forms mutually the antenna reflector of a couple which reflects a surface acoustic wave in the outside of this IDT for a drive at the IDT side for detection by position relations is shown.
[0004]Drawing 21 is a figure showing the antenna reflector of IDT for detection formed in the piezoelectric board surface of the above-mentioned surface acoustic wave gyroscopeIDT for a drive of a coupleand a couple.
[0005]The Kushigata electrode D1 of IDT101 for detection formed in the surface of the piezoelectric board 100 and IDT102103 for a drivethe distance d1 between D2and d2 have an identical pitch (1/2 of the wavelength lambda of a surface acoustic wave). The antenna reflector 104105 consists of a grating radiator which arranges the 100 line electrodes D3 with a predetermined pitch (pitch of abbreviated lambda / 2).
[0006]The piezoelectric board 100 is generating the surface acoustic wave which advances from both sides to an outside direction by each IDT102103 for a driverespectivelyand reflecting this surface acoustic wave in the IDT101 side for detection with the antenna reflector 104105The standing wave of a surface acoustic wave arises between the antenna reflectors 104105. IDT101 for detection is formed in each Kushigata electrode D1 and the prescribed position where D2 becomes a position of the paragraph of this surface acoustic wave (standing wave).
[0007]The above-mentioned surface acoustic wave gyroscope in the state where the surface of the piezoelectric board 100 was made to generate the standing wave of a surface acoustic wave. Since the surface acoustic wave (standing wave) by the Coriolis force about 90 degrees of phases shifted [Coriolis force] from this surface acoustic wave perpendicularly to the vibrating direction by a surface acoustic wave will occur if this piezoelectric board 100 rotatesThe voltage corresponding to vibration of this surface acoustic wave changed from IDT101 for detection by the piezo-electric effect is detected.
[0008]
[Problem(s) to be Solved by the Invention]By the waysince it separates from a surface

acoustic wave and he is trying for a surface acoustic wave gyroscope to detect only Coriolis force when the Kushigata electrode D1 and D2 arrange IDT101 for detection to the prescribed position used as the position of the paragraph of the standing wave of a surface acoustic waveDetecting accuracy is difficult for manufacture of a highly precise surface acoustic wave gyroscope depending on the accuracy of the mutual physical relationship of IDT101 for detectionIDT102103 for a driveand the antenna reflector 104105.
[0009]That isif the spatial phase contrast of IDT102103 for a drive and IDT101 for detection is not 90 degrees correctlythe signal component resulting from the surface acoustic wave generated by 102103 for a drive to the signal detected by IDT101 for detection is containedand it becomes a factor of a detection error.
[0010]As for the accuracy of the formation position of one of theseIDT101 for detectionIDT102103 for a driveand the antenna reflector 104105there is a fixed limit in precision improvement depending on the electrode formation art on the surface of a piezoelectric board.
[0011]In light of the above-mentioned problemsthis invention is a thing.
The purpose is to provide the surface acoustic wave gyroscope which can reduce accuracy of positionsuch as IDT for detectionwithout making it fall.

[0012]
[Means for Solving the Problem]An electrode for detection which detects Coriolis force in which this invention was formed in the surface of a piezoelectric board and the above-mentioned piezoelectric boardand voltage conversion was carried out by the piezo-electric effectAn electrode for a drive of a couple which is formed in both outsides of the above-mentioned electrode for detectionand generates a surface acoustic waveAn electrode for antenna reflectors of a couple which is formed in both outsides of an electrode for a drive of the above-mentioned coupleand reflects the above-mentioned surface acoustic wave in the above-mentioned electrode side for detectionA high frequency creating means which generates high frequency impressed to the above-mentioned electrode for a driveand a signal generating means which generates a signal equivalent to vibration based on the above-mentioned surface acoustic wave in which voltage conversion was carried out by the piezo-electric effectIt has a signal output means which outputs a difference signal of a detecting signal from the above-mentioned electrode for detectionand an output signal from the above-mentioned signal generating means (claim 1).
[0013]According to the above-mentioned compositionif high frequency of frequency f_0 is impressed to an electrode for a drive of a couplerespectivelya surface acoustic wave which vibrates by frequency f_0 to a substrate face according to an inverse piezoelectric effect will occurand this surface acoustic wave will be spread to both outsides of each electrode for a drive.
[0014]It is spread to an electrode for antenna reflectorsrespectivelyit is reflected in the electrode side for detection by this electrode pair for antenna reflectorsand a standing wave of a surface acoustic wave generates a surface acoustic wave in the inter-electrode one of a couple for antenna reflectors.
[0015]And rotational movement of a piezoelectric board will generate a surface acoustic wave of frequency f_0 based on Coriolis force about 90 degrees of phases shifted [Coriolis

force] from this surface acoustic wave in a field which intersects perpendicularly with a wave front of a surface acoustic wave in the state where a substrate face is vibrating by a standing wave of the above-mentioned surface acoustic wave. It is provided in a predetermined relation position to a standing wave of a surface acoustic wave based on Coriolis forceandas for an electrode for detectionan electrical signal which originates in Coriolis force according to the piezo-electric effect and which responds distorted and is generated is detected from an electrode for detection.
[0016]A signal equivalent to a signal which changes distortion which originates in a surface acoustic wave generated by an electrode for a drive on the other hand according to the piezo-electric effect is generatedand a difference signal of this signal and detecting signal is outputted as a detecting signal of Coriolis force. That isa signal component corresponding to a surface acoustic wave of a vibration source included in a detecting signal in an electrode for detection is removedand only a signal component corresponding to Coriolis force is outputted.
[0017]A piezoelectric board and the 1st electrode for a drive to which the 1st high frequency is impressed so that this invention may be formed in the above-mentioned piezoelectric board surface and it may generate the 1st surface acoustic waveThe 2nd electrode for a drive to which the 2nd high frequency is impressed in order to generate the 2nd surface acoustic wave that has frequency which is formed in the above-mentioned piezoelectric board surfaceand is different from the 1st surface acoustic wave of the aboveThe 1st high frequency creating means that generates the 1st high frequency of the aboveand the 2nd high frequency creating means that generates the 2nd high frequency of the aboveThe 1st electrode for antenna reflectors of a couple that is formed in both outsides of the above 1st and the 2nd electrode for a drive in order to generate a standing wave of the 1st surface acoustic wave of the aboveand reflects the 1st surface acoustic wave of the above in the 1st electrode side for a driveThe 2nd electrode for antenna reflectors of a couple that is formed in both outsides of the above 1st and the 2nd electrode for a drive in order to generate a standing wave of the 2nd surface acoustic wave of the aboveand reflects the 2nd surface acoustic wave of the above in the 2nd electrode side for a driveIt is formed in both outsides of the above 1st and the 2nd electrode for a drive in order to make into a standing wave the 3rd surface acoustic wave based on Coriolis force generated by an interaction of an interference wave of the 1st surface acoustic wave and the 2nd surface acoustic waveand rotational movement of a piezoelectric boardThe 3rd electrode for antenna reflectors of a couple that reflects the 3rd surface acoustic wave of the above in the 1st and 2nd electrode side for a driveAn electrode for detection which responds distorted and detects an electrical signal which is formed in the above 1st and the 2nd inter-electrode one for a driveand originates in the above-mentioned Coriolis force according to the piezo-electric effectand to generateIt has a signal generating means which generates a signal equivalent to vibration based on the 3rd elastic surfaces of the above in which voltage conversion was carried out by the piezo-electric effectand a signal output means which outputs a difference signal of a detecting signal from the above-mentioned electrode for detectionand an output signal from the above-mentioned signal generating means (claim 2).
[0018]According to the above-mentioned compositionif the 1st high frequency of frequency f_H ($=f_0$+deltaf) is impressed to the 1st electrode for a drivefor examplethe 1st surface acoustic wave that vibrates by frequency f_H to a substrate face according to an

inverse piezoelectric effect will occurand this 1st surface acoustic wave will be spread to both outsides of the 1st electrode for a drive.
[0019]If the 2nd high frequency of frequency f_L (=f_0-deltaf) is impressed to the 2nd electrode for a drivefor examplethe 2nd surface acoustic wave that vibrates by frequency f_L to a substrate face according to an inverse piezoelectric effect will occurand this 2nd surface acoustic wave will be spread to both outsides of the 2nd electrode for a drive.
[0020]The 1st surface acoustic wave is spread to the 1st electrode for antenna reflectors of a couplewithout being reflected by the electrode for detection2nd electrode for drive2ndand 3rd electrode for antenna reflectorsIt is reflected in the 1st electrode side for a drive by this 1st electrode pair for antenna reflectorsand a standing wave of the 1st surface acoustic wave occurs in the 1st inter-electrode one of a couple for antenna reflectors.
[0021]Similarly the 2nd surface acoustic wave is spread to the 2nd electrode for antenna reflectors of a couplewithout being reflected by the electrode for detection1st electrode for drive1stand 3rd electrode for antenna reflectorsIt is reflected in the 2nd electrode side for a drive by this 2nd electrode pair for antenna reflectorsand a standing wave of the 2nd surface acoustic wave occurs in the 2nd inter-electrode one of a couple for antenna reflectors.
[0022]In and the state where an interference wave (surface acoustic wave) of frequency f_0 occurs by the 1st and 2nd elastic-surfaces wave interference in the 1st electrode for a driveand the 2nd inter-electrode one for a driveand a substrate face is vibrating by this interference wave. Rotational movement of a piezoelectric board will generate the 3rd surface acoustic wave of frequency f_0 based on Coriolis force about 90 degrees of phases shifted [Coriolis force] from this interference wave in a field which intersects perpendicularly with a wave front of an interference wave.
[0023]It is spread to the 3rd electrode for antenna reflectors of a couplewithout being reflected by the 1st and 2nd electrode for a driveit is reflected in the electrode side for detection by this 3rd electrode pair for antenna reflectorsand a standing wave of the 3rd surface acoustic wave generates the 3rd surface acoustic wave in the 3rd inter-electrode one of a couple for antenna reflectors.
[0024]It is provided in a predetermined relation position to a standing wave of the 3rd surface acoustic wave of the aboveandas for an electrode for detectionan electrical signal which originates in the 3rd surface acoustic wave of the above according to the piezo-electric effect and which responds distorted and is generated is detected from an electrode for detection.
[0025]A signal equivalent to a signal whichon the other handchanges distortion resulting from the 3rd surface acoustic wave of the above according to the piezo-electric effect is generatedand a difference signal of this signal and detecting signal is outputted as a detecting signal of Coriolis force. That isa signal component corresponding to the 3rd surface acoustic wave of a vibration source included in a detecting signal in an electrode for detection is removedand only a signal component corresponding to Coriolis force is outputted.
[0026]
[Embodiment of the Invention]Drawing 1 is a lineblock diagram of the surface acoustic wave gyroscope concerning this invention. Drawing 2 is a figure showing the electrode structure formed in the piezoelectric board.

[0027]The gyroscope 1 is provided with the sensing element 2 which detects Coriolis forceand the high-frequency oscillators 3 and 4 which are the driving sources of a surface acoustic wave.
[0028]The transducer 22frequency f_H (=f_0+deltaf) which detect Coriolis force on this 1 surface while the sensing element 2 has the rectangular piezoelectric board 21 [Hz] The transducer 23frequency f_L (=f_0-deltaf) which generate a surface acoustic wave [Hz] The primary detecting element of the transducer 24 which generates a surface acoustic wave and a pair each of antenna reflectors 2525' (drawing 1 and "A" show.)the antenna reflector 2626' (drawing 1 and "B" show.)the antenna reflector 27and the Coriolis force that consists of 27' (drawing 1 and "C" show.) is formed.
[0029]Transducers 22-24 and antenna reflector 2525'-27and 27' is arranged by the longitudinal direction of the piezoelectric board 21 at the single tier. The transducer 22 for Coriolis force detection is arranged in the approximately center of the piezoelectric board 21As this transducer 22 is insertedon that left-hand side The surface acoustic wave of frequency f_H. (It is hereafter called the 1st surface acoustic wave.) The transducer 23 for generating is arranged and the transducer 24 for surface acoustic wave (henceforth 2nd surface acoustic wave) generating of frequency f_L is arranged on the right-hand side of the transducer 22. Antenna reflector 27'26'and 25' are arranged sequentially from [this] a central site at the outside of the transducer 24andsimilarly the antenna reflectors 2725and 26 are arranged sequentially from [this] the central site at the outside of the transducer 23.
[0030]The high-frequency oscillator 3 is an oscillator which generates the high frequency of frequency $f_H$and the high-frequency oscillator 4 is an oscillator which generates the high frequency of frequency f_L. The high-frequency oscillators 3 and 4 consist of a surface acoustic wave oscillator using the surface acoustic wave resonator constituted on the piezoelectric board which consists of the same raw material as the piezoelectric board 21Output terminal b-b' of the high-frequency oscillator 3 is connected to the transducer 23and output terminal c-c' of the high-frequency oscillator 4 is connected to the transducer 24.
[0031]In the C-B Pierce oscillating circuit shown in the B-E Pierce oscillating circuit or drawing 4 shownfor example in drawing 3the high-frequency oscillators 3 and 4 are realizable by constituting the resonant element theta from a surface acoustic wave resonator shown in drawing 5. The surface acoustic wave resonator shown in drawing 5 arranges the grating antenna reflectors (open sand mold grating antenna reflector) 29 and 30 which arrange many line electrodes D on piezoelectric board 21' at the both sides of the Inta digital type transducer (henceforth IDT) 28. The resonance frequency of the surface acoustic wave resonator of the high-frequency oscillator 3 is set as (f_0+deltaf)and the resonance frequency of the surface acoustic wave resonator of the high-frequency oscillator 3 is set as (f_0-deltaf).
[0032]As for the high frequency oscillation ways 3 and 4although the thing using the high oscillator of a crystal oscillator and other Q may be sufficient as themwhen taking into consideration stabilization of the temperature characteristics of the gyroscope 1it is preferred to constitute from an oscillator using the surface acoustic wave resonator which comprises same piezoelectric member as the piezoelectric board 21.
[0033]For examplewhen $LiNbO_3$ is used as a raw material of the large piezoelectric board 21 of electromechanical coupling coefficient k^2When the temperature

characteristics set about 70 ppm of resonance bands of ****antenna reflector 2525'-27and 27' to 5 MHzfor examplein the temperature requirement (-20 ** - 50 **) which are anticipated-use conditionsthe resonance characteristic of antenna reflector 2525'-27and 27' may shift from a predetermined resonance band. Although the antenna reflector 25 and 25' reflect the 1st surface acoustic wave and generate a standing waveit becomes impossible for exampleto obtain the standing wave of the 1st surface acoustic wave of the stable levelif the resonance characteristic of the antenna reflector 25 and 25' carries out a drift by a temperature change and sufficient reflection property is no longer obtained. This is the same also about the antenna reflector 2626' and the antenna reflector 27and 27'.
[0034]A surface acoustic wave gyroscope is what detects the Coriolis force generated by the interaction of this surface vibration and rotational movement when a piezoelectric board rotateswhere surface vibration is carried out a piezoelectric boardAlthough the stability of the frequency (namelyfrequency of a surface acoustic wave) of surface vibration of a piezoelectric board is also importantthe amplitude of surface vibration of a piezoelectric board at the point of the detection sensitivity of Coriolis force is more important.
[0035]For this reasonthe surface acoustic wave resonator which consists of the same piezoelectric member as the gyroscope 1 constitutes the oscillation element of the high frequency oscillation ways 3 and 4 from this embodimentHe is trying to attain stabilization of the standing wave of the 1st and 2nd surface acoustic wave by carrying out the drift of the oscillation characteristic of the high frequency oscillation ways 3 and 4 according to the drift of the resonance characteristic of antenna reflector 2525'26and 26'.
[0036]In this embodimentthe resonance frequency of the surface acoustic wave resonator theta of the high-frequency oscillator 3 carries out a drift to (f_0+deltaf+deltaf$_t$) from (f_0+deltaf) by a temperature changeWhen oscillating frequency is changedit is the resonance frequency (.) of the antenna reflector 25 and 25'. Namelysince the drift also of the reflection frequency is carried out to (f_0+deltaf+deltaf$_t$) from (f_0+deltaf)Also when the frequency of the 1st surface acoustic wave that the substrate face of the piezoelectric board 21 was made to generate is changedthe 1st surface acoustic wave is suitably reflected by the antenna reflector 25 and 25'and stabilization to the temperature change of the amplitude of the 1st surface acoustic wave (standing wave) is attained. Similarly the resonance frequency of the surface acoustic wave resonator theta of the high frequency oscillation way 4 carries out a drift to (f_0-delta f+delta f_t) from (f_0-deltaf) by a temperature changeSince the drift also of the resonance frequency of the antenna reflector 26 and 26' is carried out to (f_0-delta f+delta f_t) from (f_0-deltaf) when oscillation cycle change is carried outAlso when the frequency of the 2nd surface acoustic wave that the substrate face of the piezoelectric board 21 was made to generate is changedthe 2nd surface acoustic wave is suitably reflected by the antenna reflector 26 and 26'and stabilization to the temperature change of the amplitude of the 2nd surface acoustic wave (standing wave) is attained.
[0037]Thereforealthough the 1st and 2nd elastic-surfaces wave interference wave changes the frequency to (f_0+deltaf$_t$) to a temperature changethe amplitude fluctuation is reduced and can raise the temperature characteristics of the disregard level of the Coriolis force generated by the interaction of an interference wave and rotational movement of the piezoelectric board 21.
[0038]Although the high-frequency oscillators 3 and 4 may be constituted separately

from the sensing element 2they are good to form the surface acoustic wave resonator theta on the substrate of the piezoelectric board 21 preferablyand to constitute on this substrate. If it does in this waythe gyroscope 1 can be constituted compactly.
[0039]The piezoelectric board 21 consists of a member which has the piezo-electric effectsuch as lead zirconate titanate ($PbTiO_3PbZrO_3$)$LiNbO_3$and $LiTaO_3$for example. The transducers 22-24 comprise an interdigital form transducer (IDT) which forms the electrode D1 of mutually crossing Kushigataand the thin film of D2 in the surface of the piezoelectric board 21.
[0040]The frequency of a surface acoustic wave is determined in the Kushigata electrode D1 of the transducers 23 and 24and the pitch d of D2. Its high frequency is preferredwhen the frequency of the surface acoustic wave as a vibration source of the piezoelectric board 21 can select proper frequency and a miniaturization is taken into consideration. Although it is also possible to use the high frequency from the field of the Kushigata electrode D1 and the processing technology of D2 to several gigahertzhigh frequency-ization has fixed restrictions from another factorssuch as a manufacturing costand the frequency which is 10-100 MHz is usually used.
[0041]The transducer 23 (henceforth IDT23 for a drive) for the 1st surface acoustic wave generatingThe electrode D1 of Kushigata and the inter-electrode pitch d of D2 are set as wavelength lambda$_H$ (=$v_0/f_H v_0$; propagation velocity in a free surface) of the 1st surface acoustic waveAs for the transducer 24 (henceforth IDT24 for a drive) for the 2nd surface acoustic wave generatingthe electrode D1 of Kushigata and the inter-electrode pitch d of D2 are set as wavelength lambda$_L$ (=v_0/f_L) of the 2nd surface acoustic wave. IDT23 for a drive and 24 are formed in the relation position which N wave numbers (N is a natural number) of frequency deltaf may produce between IDT(s) 23 and 24 for a drive as shown in drawing 6.
[0042]The transducer 22 (henceforth IDT22 for detection) for Coriolis force detectionThe electrode D1 of Kushigata and the inter-electrode pitch d of D2 are set as wavelength lambda$_0$ (=v_0/f_0) of the surface acoustic wave (henceforth an interference wave) of frequency f_0 produced by interference with the 1st surface acoustic wave and the 2nd surface acoustic wave. IDT22 for detection is arranged so that each Kushigata electrode D1 of IDT22 for detection and D2 may be located in the position of the paragraph of the standing wave of the interference wave generated between IDT23 for a driveand IDT24 for a drive so that it may mention later.
[0043]Much the antenna reflector 2525'the antenna reflector 2626' and antenna reflectors 27and 27' consist of an open sand mold grating antenna reflector which arranges the line electrode D3 of a book with a predetermined pitch.
[0044]The antenna reflector 25 and 25' reflect the 1st surface acoustic wave in the IDT23 side for a driveand generate the standing wave of the 1st surface acoustic wave between the antenna reflector 25 and 25'. The antenna reflector 25 and 25' so that center frequency may become frequency f_H (=f_0+deltaf) of the 1st surface acoustic waveThe inter-electrode pitch P1 is set as one half of wavelength lambda$_H$ of the 1st surface acoustic waveand the number (this embodiment 100) of the line electrode D3 is set up so that bandwidth may become in less than 2deltaf. Since the reflexogenic-zone region of the antenna reflector 25 is f_H**deltaf (f_0-f_0+2deltaf)the IDT24 for drive to 2nd surface acoustic wave (frequency f_L=f_0-deltaf) is penetrated without being reflected with the antenna reflector 25and is spread to the antenna reflector 26.

[0045]The antenna reflector 25 and 25' are formed in the predetermined relation position to IDT23 for a drive so that the 1st surface acoustic wave may be reflected efficiently.
[0046]If the interval of an antenna reflector and IDT for a drive is made into the distance L of the center of line electrode D_{ref} of an antenna reflector most located in the IDT side for a driveand the center to center of Kushigata electrode D_{drv} of IDT for a drive most located in the antenna reflector side as shown in drawing 7Generally in the case of the antenna reflector of an open sand moldan antenna reflector is formed in the relation position with which this interval L is satisfied of L= (k+1/4) and lambda/2 (k= 12 and 3--). Since the wavelength (or propagation velocity) in this portion changes when there is a portion of a propagation medium which is a thing when an elastic-surfaces wave propagation medium is uniformand is different on a propagation paththe upper type needs to amend the distance of that portion.
[0047]In this embodimentsince the antenna reflector 27 is formed between IDT23 for a driveand the antenna reflector 25for example in the case of the position of the antenna reflector 25 to IDT23 for a driveIt is necessary to amend the distance of the section of the antenna reflector 27and the antenna reflector 25 is arranged at the position with which it is satisfied of the conditional expression of interval L' explained below to IDT23 for a drive.
[0048]The conditional expression of the above-mentioned interval L is determined as the standard in the wavelength lambda of the surface acoustic wave in the free surface in which the metal tunic is not formed. As shown in drawing 8in the portion in which the metal tunics Dsuch as an antenna reflectorare formed in the surface of the substrate 21as compared with a free surfacepropagation velocity becomes slowandas for the surface acoustic wave Wwavelength lambda' in a metal film formation portion becomes shorter than the wavelength lambda in a free surface seemingly.
[0049]Nowif a shortening coefficient of wavelength is set to Kdistance q-lambda for q wavelength will be shortened by K-q-lambda on the metal film formation surface in a free surface. The conditional expression of the interval L1 at the time of assuming that the antenna reflector 27 is not formed between the antenna reflector 25 and IDT23 for a drive becomes L1=(k+1/4) -lambda$_H$/2k= 12 and 3--lambda$_H$=v_0/f_H as mentioned above. Supposing the portion for r wavelength comprises the antenna reflector 27 among this interval L1the distance L2 of the portion of the antenna reflector 27 will become K-r-lambda $_0$and only -(1-K) r-lambda$_0$ will become short as compared with the case of a free surface.
[0050]Thereforethe conditional expression of interval L' between IDT23 for a drive in case the antenna reflector 27 existsand the antenna reflector 25 which should be satisfied becomes L'=L1- (1-K) and r-lambda $_0$. Nowif m and elastic-surfaces wave propagation speed in the portion of the antenna reflector 27 are made into $v_m$the number of the line electrode D3 of the antenna reflector 27Since it is m=2r and K=lambda$_m$/lambda$_0$=v_m/v_0it is -(1-K) r-lambda$_0$= $(1-v_m/v_0)$. -(m/2)- (v_0/f_0) Becoming =m-$(v_0-v_m)/(2f_0)$L' becomes like following ** type.
[0051]
[Equation 1]

[0052]For examplewhen $LiNbO_3$128-degreeX-Y is used as a piezoelectric materialsince

elastic-surfaces wave velocity v_m in 3960 m/s and a metal film formation portion are about 3920 m/selastic-surfaces wave velocity v_0 in a free surfacef_0=60MHzdeltaf = if 5 MHzk= 113and m= 100interval L' of IDT23 for a drive and the antenna reflector 25 will be set to 3424.05 micrometer (=113.5x3960/130-100x40/120).
[0053]in addition -- an antenna reflector -- 25 -- ' -- ******** -- an antenna reflector -- 25 -- the same -- detection -- ** -- IDT -- 22 -- a drive -- ** -- IDT -- 24 -- and -- an antenna reflector -- 27 -- ' -- 26 -- ' -- it can set -- wavelength -- shortening -- having taken into consideration -- a drive -- ** -- IDT -- 23 -- an antenna reflector -- 25 -- ' -- between -- an interval -- L -- " -- a conditional expression -- being satisfied -- as. It is formed in a prescribed position to IDT23 for a drive.
[0054]The antenna reflector 26 and 26' reflect the 2nd surface acoustic wave in IDT24 side for a driveand generate a standing wave of the 2nd surface acoustic wave between the antenna reflector 26 and 26'. The antenna reflector 26 and 26' so that center frequency may become frequency f_L (=f_0-deltaf) of the 2nd surface acoustic waveThe inter-electrode pitch P2 is set as one half of wavelength lambda$_L$ of the 2nd surface acoustic waveand a number (this embodiment 100) of the line electrode D3 is set up so that bandwidth may become in less than 2deltaf. Since a reflexogenic-zone region of antenna reflector 26' is f_L**deltaf (f_0-2deltaf-f_0)the IDT24 for drive to 1st surface acoustic wave (frequency f_H=f_0+deltaf) is penetrated without being reflected by antenna reflector 26'and is spread to antenna reflector 25'.
[0055]The antenna reflector 26 so that a predetermined conditional expression of an interval between IDT24 for a drive in consideration of wavelength shortening in IDT22 for detectionIDT23 for a driveand the antenna reflectors 27 and 25 and the antenna reflector 26 may be satisfiedIt is formed in a prescribed position to IDT24 for a driveand antenna reflector 26' is formed in a prescribed position to IDT24 for a drive so that a predetermined conditional expression of an interval between IDT24 for a drive in consideration of wavelength shortening in antenna reflector 27' and antenna reflector 26' may be satisfied.
[0056]The antenna reflector 27 and 27' reflect the 3rd surface acoustic wave in IDT22 side for detectionand generate a standing wave of the 2nd surface acoustic wave between the antenna reflector 27 and 27'. The inter-electrode pitch P3 is set as one half of wavelength lambda$_0$ of the 3rd surface acoustic waveand as for the antenna reflector 27 and 27'a number (this embodiment 100) of the line electrode D3 is set up so that bandwidth may become in less than 2deltafso that center frequency may become frequency f_0 of the 3rd surface acoustic wave.
[0057]Since the antenna reflector 27 and a reflexogenic-zone region of 27' are f_0**deltaf (f_0-deltaf-f_0+deltaf)The IDT23 for drive to 1st surface acoustic wave (frequency f_H=f_0+deltaf) and the IDT24 for drive to 2nd surface acoustic wave (frequency f_H=f_0-deltaf) are penetrated without being reflected by the antenna reflector 27 and 27'and are spread to antenna reflector 2525'26and 26' siderespectively.
[0058]The antenna reflector 27 so that a predetermined conditional expression of an interval between IDT22 for a drive in consideration of wavelength shortening in IDT23 for a drive and the antenna reflector 27 may be satisfiedIt is formed in a prescribed position to IDT22 for a driveand antenna reflector 27' is formed in a prescribed position to IDT22 for a drive so that a predetermined conditional expression of an interval between IDT22 for a drive in consideration of wavelength shortening in IDT24 for a

drive and antenna reflector 27' may be satisfied.
[0059]In the above-mentioned compositionif high frequency of frequency f_H and f_L is impressed to IDT23 for a driveand 24respectivelyaccording to an inverse piezoelectric effect of the piezoelectric board 21a substrate face will be displaced and the 1st surface acoustic wave and the 2nd surface acoustic wave will occur. For examplein the case of a Rayleigh wavethis wave has a displacement component in a direction and a direction of movement vertical to a substrate faceand as shown in drawing 9each particle in the surface of the piezoelectric board 21 draws an elliptical orbit rotated reversely to a direction of movementand is being displaced. Since a size of this elliptical orbit is small in a depth direction of the piezoelectric board 21 and the great portion of energy of a Rayleigh wave is concentrated on less than one wave of a depth directiona Rayleigh wave turns into a surface wave and advances.
[0060]The 1st elastic surfaces generated in IDT23 for a drive are spread from both sides of IDT23 for a drive to a longitudinal direction of the piezoelectric board 21.
[0061]In drawing 1although the 1st surface acoustic wave spread rightward from IDT23 for a drive spreads a substrate face top in which IDT22 for detectionIDT24 for a drive and antenna reflector 27'26'and 25' were formedSince IDT22 for detectionIDT24 for a drive and antenna reflector 27'and 26' have a reflexogenic-zone region in a frequency band of the 1st surface acoustic waveand a different frequency band and antenna reflector 25' has a reflexogenic-zone region in a frequency band of the 1st surface acoustic waveIn these IDT2223and antenna reflector 27' and 26'it spreads to an antenna reflector 25' sidewithout being reflected in IDT23 side for a driveand is reflected in IDT23 side for a drive by this antenna reflector 25'.
[0062]Although the 1st surface acoustic wave spread leftward from IDT23 for a drive spreads a substrate face top in which the antenna reflectors 27 and 25 were formedSince the antenna reflector 27 has a reflexogenic-zone region in a frequency band of the 1st surface acoustic waveand a different frequency band and the antenna reflector 25 has a reflexogenic-zone region in a frequency band of the 1st surface acoustic waveIn the antenna reflector 27it spreads to the antenna reflector 25without being reflected in IDT23 side for a driveand is reflected in IDT23 side for a drive with this antenna reflector 25.
[0063]And since an interval between the antenna reflector 25 and 25' is set as a predetermined interval used as an integral multiple of wavelength $lambda_H$ of the 1st surface acoustic waveAs shown in drawing 10a standing wave of frequency f_H ($=f_0$+deltaf) occurs between the antenna reflector 25 and 25' by interference with a progressive wave of the IDT23 for drive to 1st surface acoustic waveand a reflected wave of the 1st surface acoustic wave reflected by the antenna reflector 25 and 25'.
[0064]The 2nd elastic surfaces generated in IDT24 for a drive are also spread from both sides of IDT24 for a drive to a longitudinal direction of the piezoelectric board 21.
[0065]In drawing 1although the 2nd surface acoustic wave spread rightward from IDT24 for a drive spreads a substrate face top in which antenna reflector 27' and 26' were formedSince antenna reflector 27' has a reflexogenic-zone region in a frequency band of the 2nd surface acoustic waveand a different frequency band and antenna reflector 26' has a reflexogenic-zone region in a frequency band of the 2nd surface acoustic waveIn antenna reflector 27'it spreads to antenna reflector 26'without being reflected in IDT24 side for a driveand is reflected in IDT24 side for a drive by this antenna reflector 26'.
[0066]Although the 1st surface acoustic wave spread leftward from IDT24 for a drive

spreads a substrate face top in which IDT22 for detectionIDT23 for a driveand the antenna reflectors 2725and 26 were formedSince IDT22 for detectionIDT23 for a driveand the antenna reflectors 27 and 25 have a reflexogenic-zone region in a frequency band of the 2nd surface acoustic waveand a different frequency band and the antenna reflector 26 has a reflexogenic-zone region in a frequency band of the 2nd surface acoustic waveIn these IDT2223and the antenna reflectors 27 and 25it spreads to the antenna reflector 26without being reflected in IDT24 side for a driveand is reflected in IDT24 side for a drive with the antenna reflector 26.

[0067]And since an interval between the antenna reflector 26 and 26' is set as a predetermined interval used as an integral multiple of wavelength lambda_L of the 2nd surface acoustic waveAs shown in drawing 10a standing wave of frequency f_L ($=f_0-$ deltaf) occurs between the antenna reflector 26 and 26' by interference with a progressive wave of the IDT24 for drive to 2nd surface acoustic waveand a reflected wave of the 2nd surface acoustic wave reflected by the antenna reflector 26 and 26'.

[0068]Between the antenna reflector 25 and antenna reflector 26'an interference wave of frequency f_0 ($=(f_L+f_H)/2$) occurs by interference with a standing wave of frequency $f_H$and a standing wave of frequency f_L.

[0069]Where a substrate face of the piezoelectric board 21 is vibrated by the above-mentioned interference waveif this piezoelectric board 21 rotatesCoriolis force will act on this interference wave. This Coriolis force f_C is expressed with a vector type of the following ** with regards to the velocity of vibration V of particles which are carrying out the particle density rho and an elliptic movement of the piezoelectric board 21and angular-rate-of-rotation omega of the piezoelectric board 21. It is shown in ** type that a sign of a block letter is a vector.

[0070]

[Equation 1]

[0071]Nowa xy plane is shown in the surface of the piezoelectric board 21and the z-axis The normal line direction of the surface of the piezoelectric board 21If the rectangular coordinate system of xyz which makes a x axis the direction of movement of the interference wave W is set up (refer to drawing 13)the velocity of vibration V of the particles which are carrying out the elliptic movement in xz side is separable into ingredient V_x of x shaft orientationsand ingredient V_z of z shaft orientations.

[0072]Since a direction and the direction of the axis of rotation (z-axis) of velocity-of-vibration ingredient V_z are parallel when the piezoelectric board 21 rotates by angular-rate-of-rotation omega_z around the z-axisas shown in drawing 11only to velocity-of-vibration ingredient V_x of particlesCoriolis force f_{Cy} (=-2 rho-V_x and omega_z) parallel to a xy plane which intersects perpendicularly with a x axis acts. About 90 degrees of phases shift to the interference wave W by an interaction of an elliptic movement of particles and rotational movement of the piezoelectric board 21 based on the interference wave Wand it generatesand this Coriolis force f_{Cy} becomes a surface acoustic wave spread with propagation of the interference wave W synchronizing with thisas shown in drawing 12.

[0073]howevera surface acoustic wave (90 degrees of phases shifted in same frequency [as the interference wave W] f_0 -- a surface acoustic wave.) based on the above-mentioned Coriolis force f_{Cy} in between the antenna reflector 27 and 27' (it is hereafter

called the 3rd surface acoustic wave.) -- since it is set as a predetermined interval used as an integral multiple of wavelength lambda$_0$as shown in drawing 13a standing wave of the 3rd surface acoustic wave C based on Coriolis force f_{Cy} arises between the antenna reflector 27 and 27'.
[0074]Coriolis force f_C at the time of rotating by angular-rate-of-rotation omega$_x$ around a case where the piezoelectric board 21 rotates by angular-rate-of-rotation omega$_y$ around the y-axisand a x axis is as follows.
[0075]Namelywhen the piezoelectric board 21 rotates by angular-rate-of-rotation omega$_y$ around the y-axisSince the direction of the axis of rotation (y-axis) lies at right angles to both velocity-of-vibration ingredient V_x and V_zCoriolis force f_{Cz} (=2 rho-V_x and omega$_y$) and f_{Cx} (=-2 rho-V_z and omega$_y$) act to both velocity-of-vibration ingredient V_x and $V_z$respectivelyWhen the piezoelectric board 21 rotates by angular-rate-of-rotation omega$_x$ around a x axissince the direction of the axis of rotation (x axis) is parallel to the direction of velocity-of-vibration ingredient V_xCoriolis force f_{Cy} (=2 rho-V_x and omega$_z$) acts only to velocity-of-vibration ingredient V_z of particles.
[0076]Thereforeif a vector type which writes a unit vector of each shaft orientations of a x axisthe y-axisand the z-axis by $i_x i_y$and $i_z$and is shown by the above-mentioned ** formula is expressed with an all directions-oriented ingredientit will become like following ** type. It is shown in ** type that a sign of a block letter is a vector.
[0077]
[Equation 2]

[0078]From the above-mentioned ** typealthough Coriolis force f_C becomes a resultant force of the ingredient of each shaft orientations of a x axisthe y-axisand the z-axisit can separate and detect each ingredient of Coriolis force f_C by setting the mutual relation between the polarization direction of the piezoelectric board 21the electrode 23 for detectionand the surface acoustic wave W as a predetermined relation.
[0079]Thereforein this embodimentthe following explanation is carried out for the case of explanation where the piezoelectric board 21 rotates by angular-rate-of-rotation omega$_z$ around the z-axis for convenience to an example.
[0080]Drawing 13 is a figure showing the relation between the interference wave W and the 3rd surface acoustic wave C displaced to y shaft orientations produced by Coriolis force f_{Cy}.
[0081]90 degrees of phases have shifted and the 3rd surface acoustic wave C displaced to y shaft orientations produced by Coriolis force f_{Cy} to the interference wave W displaced to z shaft orientations is a standing wave between the antenna reflector 27 and 27'. Since the Kushigata electrode D1 and D2 are formed in the position (namelyposition used as the belly of the 3rd surface acoustic wave C) used as the paragraph of the interference wave WIDT22 for detectionThe Kushigata electrode D1 and the Kushigata electrode D2 are mutually displaced to an opposite direction by distortion of y shaft orientations resulting from the 3rd surface acoustic wave C (refer to the arrow direction of drawing 13)Voltage E_{DET} according to that amount of displacement occurs between the Kushigata electrode D1 and the Kushigata electrode D2 according to the piezo-electric effect of the piezoelectric board 21and this voltage E_{DET} is detected as Coriolis force f_{Cy}.
[0082]As mentioned abovethe surface of the piezoelectric board 21 is made to generate a

standing wave of the 1st surface acoustic wave of frequency f_H (=f_0+deltaf) higher than detection frequency $f_0$of Coriolis force f_{Cy} and the 2nd surface acoustic wave of frequency f_L (=f_0-deltaf) lower than detection frequency f_0While generating the interference wave W of detection frequency f_0 by both elastic-surfaces wave interferenceSince it was made to produce the antenna reflector 27 for exclusive use and a standing wave of the 3rd surface acoustic wave C that provides 27' and originates in Coriolis force f_{Cy} to Coriolis force f_{Cy} generated by an interaction of this interference wave W and rotational movement of the piezoelectric board 21A high level can detect Coriolis force f_{Cy} in which voltage conversion was carried out by the piezo-electric effect as much as possiblewithout being influenced by the 1st and 2nd surface acoustic wave and an interference waveandtherebydetection sensitivity can be raised.
[0083]By the above-mentioned embodimentas shown in drawing 1on the right-hand side of IDT22 for detectionhave arranged antenna reflector 25' to the 1st surface acoustic wave in the outermost partand arranged the antenna reflector 26 to the 2nd surface acoustic wave in the outermost part on the left-hand side of IDT22 for detectionbut. If the 3rd surface acoustic wave that is an interference wave of the 1st surface acoustic wave and the 2nd surface acoustic wave may arise between IDT23 for a driveand IDT24 for a drivearrangement of the antenna reflector 2525'the antenna reflector 2626' and the antenna reflector 27and 27' will not be limited to a relation position shown in drawing 1.
[0084]For exampleas shown in drawing 14it may be made a relation position to which arrangement with antenna reflector 25' and antenna reflector 26' was changed in drawing 1and as shown in drawing 15in drawing 1it may be made a relation position to which arrangement with **** 25 and the antenna reflector 26 was changed. As shownfor example in drawing 16may make it a relation position to which arrangement with antenna reflector 25' and antenna reflector 27' was changed in drawing 14but. As for the antenna reflector 27 and 27'when the antenna reflector 25 of the 3rd surface acoustic wave resulting from Coriolis force f_{Cy} and transmission loss in 25' are taken into considerationarranging in the innermost part is preferred.
[0085]Drawing 17 is a lineblock diagram showing a 2nd embodiment of a surface acoustic wave gyroscope concerning this invention.
[0086]A 2nd embodiment is what reduced accuracy of a formation position of IDT22 for detectionand connects the detector circuit 31 to the output terminal a of IDT22 for detectionand a' in drawing 1.
[0087]Since frequency is the same as that of an interference wave of the 1st surface acoustic wave and the 2nd surface acoustic waveand the 3rd surface acoustic wave based on Coriolis force and 90 degrees of phases differIf not correctly formed in a prescribed position to a standing wave of the 3rd surface acoustic wave that IDT22 for detection mentioned abovean ingredient of a signal which carries out piezo-electric conversion of the interference wave will be contained in a detecting signal of IDT22 for detection. The detector circuit 31 removes a signal component based on an interference wave from a detecting signal from IDT22 for detectionand extracts only a signal component based on Coriolis force.
[0088]The detector circuit 31 comprises the high-frequency oscillator 32the phase shifter 33and the differential amplifier 34 which generate high frequency of frequency f_0. The high-frequency oscillator 32 comprises an oscillator using the surface acoustic wave resonator theta of resonance frequency f_0 as well as the high-frequency oscillators 3 and 4.

[0089]The phase shifter 33 amends a phase shift based on distance difference of IDT22 for detection of high frequency outputted from the high-frequency oscillator 32and IDT23 for a drive and 24. The phase shifter 33 consists of an all path active filter of a phase leading formfor exampleand can adjust a phase of high frequency from the high-frequency oscillator 31 to arbitrary phases by the variable resistor R1.
[0090]The differential amplifier 34 is what used the operation amplifier 34athe input resistance R1 and high frequency by which phase adjustment was carried out via R3 are inputted into - input terminal of this operation amplifier 34aand a detecting signal of IDT22 for detection is inputted into + input terminal via the resistance R4. The resistance R3 and R5 comprise a variable resistor in order to adjust an input level and a gainrespectively.
[0091]The differential amplifier 34Via the phase shifter 33 from level E_{DET} of Coriolis force (signal changed into high frequency of frequency f_0 by the piezo-electric effect) detected by IDT22 for detectionand the high-frequency oscillator 31. Level difference deltaE (= E_{DET}-E_r) with level E_r of a standard height cycle of inputted frequency f_0 is amplified and outputted.
[0092]As for the detector circuit 31frequency of the high-frequency oscillator 31 and phase quantity of the phase shifter 33 are adjusted so that an output from the differential amplifier 34 may be set to "0" by a driving condition in the state where the piezoelectric board 21 has not rotated beforehand.
[0093]the above-mentioned composition **** -- high frequency of frequency f_0 which carries out piezo-electric conversion being detectedand Coriolis force from IDT22 for detectionif the piezoelectric board 21 rotatesLevel difference deltaE with level E_r of a standard height cycle of frequency f_0 inputted from disregard level E_{DET} of this high frequency and the high-frequency oscillator 31 is amplified and outputted from the differential amplifier 34.
[0094]howevera state where Coriolis force does not generate the detector circuit 31 -- that isan output from the differential amplifier 34 is set to "0" in the state where only a signal component based on an interference wave is detected from IDT22 for detection (a signal component based on an interference wave is canceled)since it is beforehand adjusted likeEven if a signal component based on an interference wave is contained in a detecting signal of IDT22 for detectiononly a signal component corresponding to Coriolis force will be outputtedand influence of an interference wave is not received from the detector circuit 31.
[0095]Thereforeby adopting this detecting methodalso when accuracy of position of IDT22 for detection is not enoughCoriolis force can be detected correctly.
[0096]Drawing 18 is a lineblock diagram of a 3rd embodiment of a surface acoustic wave gyroscope concerning this invention.
[0097]In drawing 1a 3rd embodiment IDT22 for detection of the surface of the piezoelectric board 21IDT23 for a driveIDT24 for a drivethe antenna reflector 2525'In the antenna reflector 2626' and the antenna reflector 27and the direction (y direction) that intersects perpendicularly to an arrangement direction of 27'. IDT22 for detectionIDT23 for a driveIDT24 for a drivethe antenna reflector 2525'While arranging IDT35 for detection which consists of the same structure as the antenna reflector 2626' and the antenna reflector 27and 27'IDT36 for a driveIDT37 for a drivethe antenna reflector 3838'the antenna reflector 3939' and the antenna reflector 40and 40'Each output terminal

b-b' of the high-frequency oscillator 3 and the high-frequency oscillator 4 and c-c' are connected to IDT36 for a driveand IDT37 for a driverespectively.
[0098]In a 1st embodimentsince a surface acoustic wave spread to a x direction is usedonly a y direction ingredient of Coriolis force f_C is detectablebut in a 2nd embodiment. Since a surface acoustic wave spread to a y direction is also usedit can detect also about a x direction ingredient of output terminal d-d' to Coriolis force f_C of IDT35 for detection. Even if it uses the two gyroscopes 1 concerning a 1st embodiment that made intersect perpendicularly mutually and has been arrangedsame effect is acquiredbut. Since the gyroscope 1 for two pieces is constituted on the same piezoelectric board 21 according to a 3rd embodimenta miniaturization of a gyroscope and miniaturization are attained.
[0099]Although the above-mentioned embodiment explained a surface acoustic wave gyroscope of a type which detects Coriolis force by an interaction of the 1st and 2nd elastic-surfaces wave interference wave and rotational movement of the piezoelectric board 21This invention is not limited to thiscan reflect a surface acoustic wave which the piezoelectric board 21 was made to generate with an antenna reflectorcan make it a standing waveand can be applied also to a surface acoustic wave gyroscope which detects Coriolis force by an interaction of this standing wave and rotational movement of the piezoelectric board 21.
[0100]For exampleas shown in drawing 19it is applicable also to the conventional surface acoustic wave gyroscope which has a sensing element shown in drawing 21.
[0101]Drawing 19 constitutes the C-B Pierce type high-frequency oscillator 32 of oscillating frequency f_0 which used the surface acoustic wave resonator theta (resonance frequency is f_0) on the piezoelectric board 100 in drawing 21. A bias circuit of the high-frequency oscillator 32 is omitted. An outgoing end of the high-frequency oscillator 32 is connected to IDT102103 for a driveand high frequency of frequency f_0 is impressed to IDT102103 for a drive.
[0102]Since the drift also of the resonance frequency f_0 of the antenna reflector 104105 is carried out to (f_0+deltaf$_t$) when oscillating frequency f_0 of the high-frequency oscillator 32 carries out a drift to (f_0+deltaf$_t$) by a temperature changeThe amplitude characteristic of a surface acoustic wave (standing wave) is stabilizedand the temperature characteristics of detection sensitivity of Coriolis force improve.
[0103]If the detector circuit 31 is connected to a sensing element as shown in drawing 20accuracy of position of IDT101 for detection to the antenna reflector 104105 can be reduced. Drawing 20 is connected to the phase shifter 33 of the detector circuit 31 while it connects to IDT102103 for a drive an output terminal of the high-frequency oscillator 32 formed in the piezoelectric board 21. Since a signal component on which a surface acoustic wave is based is canceled by the differential amplifier 34this embodiment can also detect only a signal component corresponding to Coriolis force from a detecting signal of IDT101 for detection.
[0104]
[Effect of the Invention]As explained abovethe surface of this invention ****** and a piezoelectric board is vibrated by the standing wave of a surface acoustic waveIn the surface acoustic wave gyroscope which changes into an electrical signal the Coriolis force generated in the substrate face by the interaction of this vibration and rotational movement of a piezoelectric board according to the piezo-electric effectand detects itThe

signal generating means which generates the signal equivalent to the vibration based on the above-mentioned surface acoustic wave in which voltage conversion was carried out by the piezo-electric effectThe signal output means which outputs the difference signal of the detecting signal from the electrode for detection and the output signal from a signal generating means which detect Coriolis force is establishedSince reason ********** was removed from the detecting signal from the electrode for detection to the surface acoustic wave which is a vibration sourcealso when the signal component resulting from a surface acoustic wave is contained in the detecting signal from the electrode for detectionCoriolis force can be detected correctly. This becomes possible to reduce the accuracy of the formation position of the electrode for detection.

[0105]The 1st electrode for a drive that generates the 1st surface acoustic wave on the surface of a piezoelectric board according to this inventionWhile arranging the electrode for detection which detects the 3rd surface acoustic wave resulting from the 2nd electrode for a drive and Coriolis force that generate the 2nd surface acoustic wave of different frequency from the 1st surface acoustic wave to a single tier on both sides of this electrode for detectionthe [the 1st of opposite structure which reflects the 1st - the 3rd surface acoustic waverespectively in order to make the both outsides of the 1st and 2nd electrode for a drive generate a standing wave -] -- the electrode for antenna reflectors of three[arrange and] It makes the 1st and 2nd inter-electrode one for a drive generate the interference wave of the 1st and 2nd surface acoustic wave (standing wave)It is a surface acoustic wave gyroscope which detects the electrical signal which resonated the Coriolis force (standing wave of the 3rd surface acoustic wave) produced by the interaction of this interference wave and rotational movement of a piezoelectric boardand was transformed into voltage by the electrode for detectionThe signal generating means which generates the signal equivalent to the vibration based on the 3rd elastic surfaces in which voltage conversion was carried out by the piezo-electric effectSince the signal output means which outputs the difference signal of the detecting signal from the electrode for detection and the output signal from the above-mentioned signal generating means is established and reason ********** was removed from the detecting signal from the electrode for detection to the 3rd surface acoustic wave that is a vibration sourceAlso when the signal component resulting from the 3rd surface acoustic wave is contained in the detecting signal from the electrode for detectionCoriolis force can be detected correctlyand this becomes possible to reduce the accuracy of the formation position of the electrode for detection.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a lineblock diagram of the surface acoustic wave gyroscope concerning this invention.

[Drawing 2]It is a figure showing the electrode structure formed in the piezoelectric board.

[Drawing 3]It is a figure showing the basic circuit composition of the high-frequency oscillator using a surface acoustic wave resonator.

[Drawing 4]It is a figure showing other examples of the basic circuit composition of the

high-frequency oscillator using a surface acoustic wave resonator.
[Drawing 5]It is a top view showing the structure of a surface acoustic wave resonator.
[Drawing 6]It is a figure showing the mutual relation position of IDT for a drive of the couple to a surface acoustic wave.
[Drawing 7]It is a figure showing the definition of an interval with IDT for a driveand an antenna reflector.
[Drawing 8]It is a figure for explaining shortening of the wavelength of the surface acoustic wave in the metal tunic surface.
[Drawing 9]It is a figure showing displacement of the particles of the substrate face in a Rayleigh wave.
[Drawing 10]It is a figure showing the frequency of the standing wave generated between each antenna reflector.
[Drawing 11]It is a figure showing the generating direction of the Coriolis force to the elliptic movement of the particles by a surface acoustic wave.
[Drawing 12]It is a figure showing the elastic-surfaces wave propagation based on a surface acoustic wave and Coriolis force.
[Drawing 13]It is a figure showing the relation between an interference wave and the 3rd surface acoustic wave displaced to y shaft orientations produced by Coriolis force f_{Cy}.
[Drawing 14]It is a figure showing a 2nd embodiment of the locating position of the antenna reflector formed in the piezoelectric board.
[Drawing 15]It is a lineblock diagram of a 3rd embodiment of the locating position of the antenna reflector formed in the piezoelectric board.
[Drawing 16]It is a lineblock diagram of a 4th embodiment of the locating position of the antenna reflector formed in the piezoelectric board.
[Drawing 17]It is a lineblock diagram of a 2nd embodiment of the surface acoustic wave gyroscope concerning this invention.
[Drawing 18]It is a lineblock diagram of a 3rd embodiment of the surface acoustic wave gyroscope concerning this invention.
[Drawing 19]It is a lineblock diagram of a 4th embodiment of the surface acoustic wave gyroscope concerning this invention.
[Drawing 20]It is a lineblock diagram of a 5th embodiment of the surface acoustic wave gyroscope concerning this invention.
[Drawing 21]It is a figure showing IDT for detectionIDT for a driveand the antenna reflector which were formed in the piezoelectric board of the conventional surface acoustic wave gyroscope.
[Description of Notations]
1 Gyroscope
2 Sensing element
3 high-frequency oscillator (1st high frequency creating means)
4 high-frequency oscillator (2nd high frequency creating means)
21100 Piezoelectric board
22 IDT for detection (electrode for detection)
23 IDT for a drive (1st electrode for a drive)
24 IDT for a drive (2nd electrode for a drive)
25 and 25' antenna reflector (1st electrode for antenna reflectors)
26 and 26' antenna reflector (2nd electrode for antenna reflectors)

27 and 27' antenna reflector (3rd electrode for antenna reflectors)
28 IDT
29 and 30 Antenna reflector
31 Detector circuit
32 High-frequency oscillator (high frequency creating means)
33 Phase shifter (signal generating means)
34 Differential amplifier (signal output means)
34a Operation amplifier
35 IDT for detection
36 IDT for a drive
37 IDT for a drive
38 38' Antenna reflector
39 39' Antenna reflector
40 40' Antenna reflector
101 Drive IDT (electrode for detection)
IDT for 102103 drive (electrode for a drive)
104105 Antenna reflector (electrode for antenna reflectors)
theta Surface acoustic wave resonator